

A visionary biologist says mushrooms are potent antiviral and antibacterial agents, as well as key boosters to the human immune system. They also might end up saving the earth. To lots of folks, a middle-aged man who says mushrooms can save the world falls into the category of turbo-freak. But to some environmentalists, scientists and major investors, Paul Stamets is the trippiest of profitable kings.

"Mushrooms restore health both on the personal and ecological level," says Stamets, a mycologist and owner of Fungi Perfecti, a family-owned mushroom business in Shelton, Wash. "Mushrooms can heal people and the planet."

Stamets, a former logger turned scanning electron microscopist, is bent on showing that fungal mycelium and mushrooms (the actual mushroom is the fruit of the mycelium) could be the cornerstone to several earth-friendly, multibillion dollar industries. To him, there's no end to what spores can do.

Collaborating with public and private agencies from Battelle Industries to the National Institutes of Health, Stamets is giving 'shrooms their 15 minutes of fame, promoting them as antiviral and antibacterial agents, as well as key boosters to the human immune system.

Outside the body, Stamets says he has cloned mycelia and mushrooms that can kill pests, absorb radioactive material, filter toxic wastes and, according to an article in Jane's Defense Weekly, even degrade surrogates of deadly VX and sarin gas.

Stamets, who has collected over 250 strains of wild mushrooms, says that until now they were largely ignored by environmentalists and scientists. He has filed for dozens of patents, he says, with more to follow. "Every failure is a cost of tuition of the education you have come to learn," he says, "You graduate to greater and greater techniques."

Mushrooms themselves graduated through evolution to become acute survivors that recycle life after devastation. About 250 million years ago, after a massive extinction from a meteorite, Stamets says fungi inherited the earth and "recycled the postcataclysmic debris fields."

Today they are a keystone species spanning large swaths of land and secreting enzymes and acids that break down plant matter (which, luckily enough, have chemical bonds similar to contaminants like petroleum and pesticides).

"The 21st century will be the century of the biologist," Stamets says in nod to technologies that are exposing life's basic microcellular relationships. Teasing apart those relationships has helped Stamets come up with some radically successful models. One aims to stop silt runoff on logging roads, for example, by spreading bark and wood chips that have been coated with mycelia of local native fungal species. The mycelia's natural filtration properties stop the silt flow and prompt the regrowth of the topsoil.

In another technique he calls "mycorestoration," Stamets uses fungi to filter out pathogens, silt

and chemicals from water (mycofiltration) and to denature toxic wastes. The low-tech devices--which often involve placing the fungi in straw, for example--can be placed around farms, watersheds, factories and roads.

Stamets also uses fungi to hurry the natural decomposition of logs on the forest floor. Knowing that local habitat better evolves when the sequence of decomposition is sped up (rather than burned), Stamets devised a way to put spores in chainsaw oil. The result: when a logger cuts a tree, he also coats it with spores that help it decompose.

As proof of mushrooms' ability to mop up humanity's deadly mistakes, Stamets tells of mushrooms growing near Chernobyl that were found to have accumulated high levels of the deadly cesium 137 that leaked from faulty reactors. Why not put mushrooms near environmentally wrecked sites, allowing them to work as a natural immune system?

Stamets' key project--which has attracted the attention of Ben Du Pont, an investor from the famed family--is U.S. patent number 6,660,290.

Somewhere during his study of the dialectic relationship between fungi and insects, Stamets came up with a way to use one to kill the other. "Mycopesticides," he says, are nonpolluting tools that could upend the global pesticide industry.

One version of the idea involves using parasitic fungi that act on specific insects. The fungus, which can be presented on tasty foods like grain, kills the pest when digested.

Du Pont's company, Yet2.com, matches new technologies with bigger business partners. Stamets, however, wouldn't discuss Yet2's plans for his pesticides, saying only that the group is involved in talks with major companies.

Kind and undeniably brilliant, Stamets' passionate, rapid-fire descriptions of fungal experiments and patents can give the feeling he's a mix of scientist, inventor, environmentalist and snake-oil salesman. He admits he has his detractors ("Some mycologists think I'm a heretic," he shrugs), but he also has a loyal following.

"There are very few people capable of combining the breadth of understanding and the academic rigor to naturally based problem solutions [like] Paul," says Dr. Eric Rasmussen, formerly of the Defense Advanced Research Projects Agency, the Pentagon's high risk, high-payoff scientific entity. "His combination of factors in his intellect and experience are a somewhat rare combination. And his work is likely to prove to have significant benefit to the United States."

(Though he would not discuss details, Stamets says he has isolated a strain of mushroom from the Old Growth forest that has shown activity against viruses that could be potentially weaponized.)

Phil Stern of Yet2 says that for all Stamets' scientific acumen, at the end of the day, he's about his beliefs.

"One of the best things about Paul is not just his groundbreaking technology but his principals," says Stern. "He says, 'If I license this product to you, you have to uphold these principals.' I respect his integrity."

Stamets has a few things working against him, especially when promoting his ideas in the mental lockdown of 21st-century America. He did, after all, conduct now-famous research on psilocybin hallucinogenic mushrooms at Evergreen State College in the late 1970s. And he wrote that stoner classic, *Psilocybin Mushrooms of the World*.

What's more, to conservative minds, the trippy-dippiness of some of his ideas can come off as silliness. In one breath, for example, he ticks off a riveting observation that our neurological landscape looks like mycelium or that brain neurons and the Internet share mycelia's basic structural arrangements. In another he talks of "fungal intelligence" or the possibility of using spores to put life on other planets.

In the draft of his new book, *Mycelium Running: Growing Mushrooms to Heal People and Planet*, Stamets writes that, "The mycelium is an exposed sentient membrane, aware and responsive to changes in its environment. I especially feel this when I enter a forest after a rainfall. Interlacing mycelial membranes form, I believe, a complex neuron-like web that acts as a fungal collective consciousness."

Whether or not corporate investors will ever vibe with the fungal collective consciousness, Stamets says his ideas are helped by a shift in scientific culture that's more accepting of non-Western, natural solutions to problems.

And he's never short of evidence to back his theories.

"The idea that a cellular organism demonstrates intelligence may seem radical if not for work by researchers like Toshuyiki Nakagami, published in *Nature* 2000," Stamets writes. "He placed a maze over an agar-filled petri dish and introduced nutritious oat flakes at the entrance and exit. He then inoculated the entrance with a culture of the slime mold *Physarum polycephalum* under sterile conditions. It grew through the maze and consistently chose the shortest route to the oat flakes at the end. Rejecting dead-ends, the slime mold demonstrated, according to the researchers, a form of intelligence."

That intelligence, according to Stamets, might one day be used to extend life throughout the solar system. Mushrooms are the first organism to restart an ecosystem after catastrophes like tornadoes or forest fires, popping up from the ground to return nutrients back to the food chain. The mushrooms' scent attracts insects, which then attract birds and animals that bring in seeds, creating a life generation domino effect that underscores the possibility of using fungi for creating habitats on other worlds.

For now, Stamets' most secure convictions are planted here on Earth.

"I believe ecosystems are conscious," he says. "These mycelia networks, like the Internet, share information on changes in the environment such as the availability of new food sources

or responses to cataclysmic changes. So really these are information-sharing networks," he reasons.

"I think science will prove they have a form of consciousness that we do not recognize."

By Kelly Hearn